## REMARKS

Claims 1, 2, and 4-26 are pending in the present application. In the Office Action mailed May 27, 2009, the Examiner rejected claims 20-26 under 35 U.S.C. §101. The Examiner next rejected claims 1, 2, 5-9, 13, 16-19, and 24-26 under 35 U.S.C. §103(a) as being unpatentable over Kruger (USP 6,216,025) in view of Bae et al. (US Pub. 2007/0740541). Claim 4 was rejected under 35 U.S.C. §103(a) as being unpatentable over Kruger in view of Bae et al. as applied to claim 1, and further in view of Takashima (JP363211879). Claims 10-12, 14, and 15 were rejected under 35 U.S.C. §103(a) as being unpatentable over Kruger in view of Bae et al. as applied to claims 1 and 13, and further in view of Ben-Haim et al. (US Pub. 2002/0065455). Claims 20, 21, and 23 were rejected under 35 U.S.C. §103(a) as being unpatentable over Kruger in view of Bae et al., and further in view of Ben-Haim et al. Claim 22 was rejected under 35 U.S.C. §103(a) as being unpatentable over Kruger in view of Bae et al. as applied to claim 20, further in view of Ben-Haim et al., and further in view of Maas, III (USP 6,181,832).

### Claim Objections

Claims 1-26 were objected to by the Examiner (though claim 3 has been previously canceled). Applicant respectfully points out to the Examiner the long file history for this Application and further points out that most of the issues to which the Examiner now objects have been present in the claims since originally being filed. The file history includes three previous office actions, an Advisory Action, and a successfully argued Pre-Appeal Conference Request, during which none of these claim objections were made. Aside from the antecedent issue of claim 1, Applicant believes that none of the claims is unclear or merits an objection. Nevertheless, to advance prosecution, Applicant has amended the claims in question.

Regarding claims 1, 13, 20, and 24 the Examiner stated that TCT should be defined in the claims. *Office Action*, 05/27/09, pg. 2. Claims 1, 13, 20, and 24 have been amended to define TCT as thermoacoustic computed tomography, consistent with the Specification.

Regarding claim 1 the Examiner stated that "the imaging object" lacked antecedent basis. *Id.* Claim 1 has been amended to clarify that a first set of TCT data is acquired from a measurement surface of an imaging object, thus rendering the objection moot.

Regarding claim 13, the Examiner stated that "it is unclear what 'an admissible sensor position' is." *Id.* Applicant has amended claim 13 to call for, in part, a computer programmed to derive, from the acquired data, unacquired data for the imaging object for one or more locations inadmissible for sensor positioning due to a positioning of the imaging object.

Regarding claim 16, the Examiner stated that "near-infrared energy would be a type of infrared energy, so it is unclear why infrared energy is also listed as one of the components of the energy used." *Office Action*, 05/27/09, pg. 2. Applicant points out that near-infrared and infrared include different portions of the energy spectrum, and both are properly called for in claim 16. Nevertheless, to clarify the claimed subject matter, Applicant has amended claim 16 to call for "wherein the energy to induce thermal expansion includes one of RF energy, infrared energy, and near-infrared energy."

Regarding claim 17, claim 17 has been amended to call for the imaging system of claim 16 configured to determine presence of an abnormality of breast tissue.

Accordingly Applicant requests withdrawal of the objections to claims 1, 2, and 4-26.


## Claim Rejections, §101

Claims 20 and 24 were rejected under 35 U.S.C. §101. Regarding both claims, the Examiner stated, "[T]he claim [sic] does not require the step of reconstructing an image based on the first set and the second set of TCT data and therefore does not require any physical transformation and the invention as claimed does not produce any apparent useful, concrete and tangible result." *Id.* Claim 20 has been amended to call for a computer caused to generate an image using at least the TCT data determined from the coefficients. Claim 24 has been amended to call for generating an image using at least the second TCT dataset. Thus, Applicant requests withdrawal of the rejections of claims 20 and 24 under 35 U.S.C. §101, and the claims that depend therefrom.


## Claim Rejections, §103

Claims 1, 13, and 24 were rejected under 35 U.S.C. §103(a) as being unpatentable over Kruger in view of Bae et al. Claims 1, 13, and 24 have been amended. Nowhere does Kruger, Bae et al., or any combination thereof teach or suggest that called for in claims 1, 13, and 24. In particular, nowhere does either reference, alone or in combination, teach or suggest determining a second set of TCT data from the first set of TCT data for a second measurement surface that cannot be accessed by TCT transducers as called for in claim 1. Nowhere does either reference, alone or in combination, teach or suggest a computer programmed to derive, from the acquired data, unacquired data for the imaging object for one or more locations inadmissible for sensor positioning due to a positioning of the imaging object as called for in claim 13. Nowhere does either reference, alone or in combination, teach or suggest deriving a second TCT dataset from

the first TCT dataset, the second TCT dataset including data for transducer locations mirrored from the first set of transducer locations as called for in claim 24.

Kruger teaches specific arrangements of multiple transducers on a rotatable imaging bowl for measuring acoustic waves produced in tissue when the tissue is exposed to electromagnetic radiation. *Kruger,* Abstract. Kruger describes acoustic shielding techniques to minimize stray echoes and sources of noise, techniques for cancelling noise, modulation of the time between imaging pulses to randomize the effect of acoustic echoes, and a filtering technique applied to compensate for the frequency response of the transducers. *Id.,* Col. 3., lns. 15-26. "The aim is to reconstruct some property of the breast from an ensemble of pressure measurements made externally to the breast." *Id.,* Col. 10, lns. 18-20. "An array of sixty-four acoustic transducers 33 is located within imaging bowl 14 in tank 16 [sic]." *Id.,* Col. 6, lns. 1-2. The transducers should be evenly spaced across the array, and are positioned in connection to Fig. 6. *Id.,* Col. 6, lns. 3-5.

Thus, Kruger teaches arrangements of transducers and techniques for measuring acoustic waves in tissue when the tissue is exposed to electromagnetic radiation.

Bae et al. is directed toward CT imaging and at the cited location, Bae et al. teaches that "[t]he preferred slice thickness and reconstruction interval for the CT slices is 1 mm or less," but the algorithm disclosed therein can accommodate different slice thicknesses and reconstruction intervals. *Bae et al.,* Para. [0054]. "After the boundary of the lung region is refined as described above in connection with FIG. 2, the 2D segmented lung regions can be stacked to generate a 3D volumetric data set of the lung region." *Id.* "If the reconstruction interval is larger than 1 mm, finer-resolution slices can be interpolated at every 1 mm using the slice neighboring above and the slice neighboring below and integrated into the expanded 3D volumetric dataset." *Id.*

Thus, Bae et al. teaches interpolation of CT data. Incidentally, the Examiner alleged that Bae et al. teaches extrapolating data at the cited location, and based the rejections of claims 1, 13, and 24 on that interpretation. However, as is evident from the citations above, nowhere does Bae et al. suggest anything to do with extrapolation of data. Interpolation of data is different than extrapolation of data, and nowhere does Bae et al. teach or suggest extrapolation of data.

In the Response to Arguments, the Examiner advanced an unsustainable assertion that "interpolation in three dimensions is a type of extrapolation" (*Office Action,* 05/27/09, pg. 9) More specifically, the Examiner stated, "As understood in colloquial terms, extrapolation involves creating data in between existing data, based on existing data." *Id* (emphasis added). The Examiner also stated that "[i]nterpolation involves creating data in between existing data, based on existing data." *Id.* The Examiner concluded, "Therefore, in three dimensional

reconstruction, the teaching of interpolation certainly satisfies the definition of extrapolation." *Id.* Clearly this logic is faulty, and nowhere has the Examiner provided any analysis or source to support the determination that "the teaching of interpolation certainly satisfies the definition of extrapolation" or that "extrapolation involves creating data in between existing data." The Examiner has hinged the rejection of claims 1, 13, and 24 on this interpretation, yet nowhere has the Examiner provided any analysis or support for this position other than a mere statement of an unsubstantiated position.

Clearly interpolation and extrapolation are different from one another, and both terms suggest different methods of manipulating data. As is commonly known, interpretation includes calculation of a value of data within a range of known values, such as in, for instance, Bae et al. at Para. [0054] – "if the reconstruction interval is larger than 1 mm, finer-resolution slices can be interpolated at every 1 mm using the slice neighboring above and the slice neighboring below and integrated into the expanded 3D volumetric dataset." In contrast, extrapolation applies to calculation of data outside a range of known values, such as in, for instance, the instant application where "the mathematical underpinnings of determining or otherwise extrapolating data corresponding to the unmeasured transducer locations from the data of the measured locations are set forth" and "TCT data is estimated or otherwise determined for inadmissible transducer locations." *Specification,* pg. 10, lns. 10-20. Such descriptions are consistent with the commonly understood definitions where interpolation includes calculation of a value of data within a range of known values (Bae, et al.) and extrapolation includes calculation of a value of data outside a range of known values (Specification).

Thus, with this distinction in-hand, the combination of Kruger and Bae et al. does not result in the claimed subject matter. As stated, Kruger teaches an array of transducers that acquires data over a spherical surface, and Bae et al. teaches interpolation of data. In combination, Kruger and Bae et al. at best teach a system having an array of transducers (Kruger) and data interpolated between locations where transducers are placed (Bae et al.). Nowhere does either reference, alone or in combination, teach or suggest that data may be extrapolated as alleged by the Examiner.

Nevertheless, to clarify the claimed subject matter and advance prosecution, Applicant has elected to amend claims 1, 13, and 24.

That called for in claims 1, 13, and 24 is neither taught nor suggested in Kruger, Bae et al., or a combination thereof. Accordingly, Applicant believes that claims 1, 13, and 24, and the claims that depend therefrom, are patentable over the art of record.

Claim 20 was rejected under 35 U.S.C. §103(a) as being unpatentable over Kruger in view of Bae et al., and further in view of Ben-Haim et al. Claim 20 has been amended and calls for, in part, a computer readable storage medium having a computer program stored thereon and representing a set of instructions that when executed by a computer causes the computer to determine coefficients of a polynomial expression that is relative to a position of a transducer about an imaging object, acquire thermoacoustic computed tomography (TCT) data from the imaging object, and from the coefficients, determine TCT data corresponding to a desirable transducer location about the imaging object not accessible to a TCT transducer.

The Examiner relied on Ben-Haim et al. for teaching the use of a Legendre Polynomial, apparently relying on Kruger and Bae et al. for the remaining aspects of the claimed subject matter. Thus, specifically to claim 20, the Examiner has apparently relied on Ben-Haim et al. for teaching a computer caused to determine coefficients of a polynomial expression.

Ben-Haim teaches a locating system for determining the location and orientation of an invasive medical instrument relative to a reference frame. *Ben-Haim, Abstract.* The position and orientation of a distal end of a catheter are ascertained by use of two or three antennas, such as radiators 18, 20, and 22. *Id.,* Para. 103. The three radiators are driven by a radiator driver 24 and, along with a signal processor 26, provide "a display or other indication of the position and orientation of the distal end 15 on a monitor 27." *Id.,* Par. 105. "[T]he field equations are derived specifically for each embodiment and are dependent on the geometry and characteristics of the radiators." *Id.,* Par. 147. In the preferred embodiment where the radiators are coils, for a coil with N turns, radius R, and current I, a series of vector equations are generated wherein a radial and tangential component are described. *Id.,* Pars. 147-148. The tangential component includes an expression, $P_n(x)$, which is a Legendre Polynomial of degree n which may be calculated recursively through the method described. *Id.,* Pars. 149-153. Thus, the field sensed by a remote sensor results in equations having known and unknown variables for any given coil. *Id.,* Pars. 154-155. In the embodiment having three sensors, the technique described results in an overdetermined series of nine equations and six variables and, with nine sensor readings, the unknowns may be numerically solved for by using, for instance, a Newton-Raphson method for non-linear systems, and "[t]he location sensor position and orientation are displayed on monitor 27." *Id.,* Pars. 158-159.

Thus, Ben-Haim et al. describes obtaining a location and orientation of an invasive medical instrument using a numerical solution that includes a Legendre Polynomial.

As such, nowhere does Ben-Haim et al. teach or suggest determining TCT data corresponding to a transducer location about the imaging object not accessible to a TCT transducer. Nowhere does Kruger, Bae et al., or Ben-Haim et al., alone or in combination, teach or suggest that called for in claim 20. Although Ben-Haim et al. describes the use of a Legendre Polynomial, Ben-Haim et al. does not make up for the deficiencies of the other two references. Thus, nowhere does Kruger, Bae et al., Ben-Haim et al., or a combination thereof teach or suggest obtaining data that corresponds to a transducer location not accessible to a TCT transducer.

Thus, that called for in claim 20 is neither taught nor suggested in Kruger, Bae et al., Ben-Haim et al., or a combination thereof. Accordingly, Applicant believes that claim 20 and the claims that depend therefrom, are patentable over the art of record.

Therefore, in light of at least the foregoing, Applicant respectfully believes that the present application is in condition for allowance. As a result, Applicant respectfully requests timely issuance of a Notice of Allowance for claims 1, 2, and 4-26.

Applicant appreciates the Examiner's consideration of these Amendments and Remarks and cordially invites the Examiner to call the undersigned, should the Examiner consider any matters unresolved.

Respectfully submitted,

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## General Authorization and Extension of Time

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 07-0845. Should no proper payment be enclosed herewith, as by credit card authorization being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 07-0845. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extensions under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 07-0845. Please consider this a general authorization to charge any fee that is due in this case, if not otherwise timely paid, to Deposit Account No. 07-0845.

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